ATCOR

APC-1000
Airborne Particle Counter

Operations Manual
Version 97-06

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SAFETY PRECAUTIONS

LASER OPTICS

The APC-1000 Airborne Particle Counter complies with FDA Laser Performance Standard 21 CFR 1040.10 and 1040.11.

This instrument contains a class IIIb laser diode with a rated power output of 20 milliwatts at a wavelength of 820 nanometers. The laser diode is in a closed assembly inside the sensor case. Warning labels cover all parts that may allow exposure to class IIIb laser radiation if disassembled.

Note: There are no user serviceable components in the APC-1000. Tamper proof screws are used to secure the cover to the sensor case. Send the complete instrument to an authorized Biotest service center for repair or calibration. Failure to follow the manufacturer's recommendations may damage the APC-1000 and will void the warranty.

ELECTRICAL

The APC-1000 contains a 6 volt sealed lead acid battery. A 6 volt/200 milliamp battery recharger, specifically designed for use with lead acid batteries, is provided. The battery recharger has an input voltage of either 120 or 220 volts with a power dissipation of 5.5 VA. When the battery is fully charged, the battery recharger reaches a floating point and the charging process terminates itself automatically.

Note: The APC-1000 is a sensitive instrument. It should not be used in a manner that is inconsistent with its intended use. This includes using the proper battery charger, ensuring that the charger is plugged into the intended power receptacle, and connecting the counter to a computer or printer only as described in this manual. The APC-1000 should only be used in atmospheric pressure air (see section 3.2.1).

1. INTRODUCTION

The APC-1000 particle counter is a simple yet sophisticated data collection and storage instrument. The quickest way to learn the basics of operation is to review the general counting procedure section of this manual (section 3.2) while operating some of the keypad functions. However, we recommend you review the entire manual to familiarize yourself with all the capabilities of the APC-1000.

2. APC-1000 DESCRIPTION

The APC-1000 precisely measures the quantity of airborne particles with diameters equal to or greater than a set of fixed size thresholds. It also simultaneously provides accurate temperature, relative humidity and time data. The instrument is composed of four modules: the sensor, pump, battery, and electronics.

The sensor module contains the optical components and temperature and relative humidity detectors. Within the particle sensor, light emitted from the laser diode is focused by a series of lenses through a particle sensing zone into a light trap. When a particle enters the sensing zone, it scatters the beam. Scattered light is collected by a second set of lenses and focused onto a solid state photo detector. The amplitude of the electrical signal produced by the photo detector is dependent on the size of the particle in the sensing zone.

The pump module draws air through the isokinetic probe, past the temperature and humidity sensor, and into the particle sensing zone. The pump pulls in 0.1 cubic feet per minute of air.

The battery module supports operation of the APC-1000 for up to eight hours without a recharge. The sealed lead acid battery has an output voltage of 6 volts at 1.3 Amphours.

The central processing electronics module regulates the sensor, pump and battery. The electronics also simultaneously maintain communications when connected to an IBM compatible personal computer.

3. OPERATION

Note: Always turn off the power (on/off key) to the APC-1000 Airborne Particle Counter before connecting or disconnecting any cables.

Note: For sampling air under pressure, see section 3.2.1.

Note: The unit itself must, on no account, be autoclaved, but may be disinfected by wiping down with alcohol or commercial disinfectants. No liquids may be aspirated into the inlet of the particle counter, or the optics and/or humidity sensor may be damaged and require repair.

3.1 KEYPAD FUNCTIONS

Functions are selected through the keypad on the APC-1000 front panel. The LCD display indicates whether a function is currently enabled. The following sections describe each of the separate functions. The key labels are indicated in bold face type.

3.1.1 Particle Size

0.3, 0.5, 1.0 and **5.0** -- The APC-1000 detects particles relative to four thresholds: greater than 0.3, 0.5, 1.0, and 5.0 microns. The information is gathered for all particle thresholds simultaneously. Any one channel can be displayed on the LCD at any time. The particle size displayed on the LCD is controlled by pressing one of these four buttons. When the APC-1000 is turned on, press any of the four buttons to select the particle range of interest. The current particle range is displayed on the top center of the LCD readout.

3.1.2 Counting Mode

SNGL, AUTO, and **CONT** --

In SNGL (single) mode the instrument will sample for the pre-selected counting time then stop.

In AUTO (automatic) mode the instrument will sample for the pre-selected counting time, hold for a predetermined period in standby mode, then repeat this sequence continually. The standby period depends upon the length of the pre-selected counting time. If you select a count time of 5 minutes or less, the standby time will be 15 seconds. A 1 minute standby time will occur when the pre-selected sample time is greater than 5 minutes. This standby/sample time sequence will be repeated indefinitely automatically.

In CONT (continuous) mode the instrument will sample continuously until **START/STOP** is pressed.

To select the mode, simply press the appropriate key. The currently selected mode is displayed in the bottom left corner of the LCD.

3.1.3 Start/Stop

START/STOP -- When the unit is on, press the **START/STOP** button to begin or end a counting sequence.

3.1.4 Particles per Cubic Foot Display Mode

/FT^3 -- Particle counts can be displayed either as an actual count in number of particles or in particles per cubic foot. To display particles per cubic foot, press the **/FT^3** key. When in this mode, "/FT^3" will appear on the upper right corner of the LCD display. When calculating particles per cubic foot, the actual particle count is divided by the volume of air sampled.

Note: Although the particle per cubic foot information is correct, displaying the data in /FT^3 mode may cause erratic readings at the beginning of the sample period because of statistical variations due to short sample times. Also, the display will not converge to the final concentration until 10 seconds have passed. If the particle counter is stopped prior to 10 seconds, there will be an abrupt change in the particle concentration. The final value is correct.*

****For Example:***

If two 5.0 micron particles are detected after 15 seconds of sampling, the instantaneous count in 5.0 micron particles/cubic foot is:

2/(0.25 min * 0.1 cfm) = 80 five micron particles/cubic foot

If another 5 seconds of sample time passes with no additional particles detected, the instantaneous count in particles per cubic foot changes to:

2/(0.33 min * 0.1 cfm) = 60 five micron particles/cubic foot

Hence, the count in particles per cubic foot can fluctuate greatly and even appear to decrease at the beginning of the sample time. The count will stabilize further into the sample period.

3.2 GENERAL COUNTING PROCEDURE

To begin counting, press the **ON/OFF** button to power up the unit. The LCD display should light up. If the LCD display will not turn on, it's likely your unit needs recharging. The LCD display will display the latest stored data prior to the last power off.

Select the appropriate operating options on the soft touch keypad including particle size, display mode (total particles or particles per cubic foot) and sampling mode (single, automatic or continuous). Update the count time, date and time as necessary using the **MODE** key.

Remove the isokinetic probe (the 3" long by ½" diameter black tube) from the carrying case and screw it into the top receptacle on your APC-1000. Be careful not to overtighten. To begin counting, press the **START/STOP** button.

3.2.1 Operating the APC-1000 in Pressurized Environments

The APC-1000 may be used in pressurized cleanrooms provided that the air inlet and outlet are at the same pressure. Basically, this means keeping the inlet of the isokinetic probe in the same environment as the rest of the APC-1000. Placing the inlet at a different pressure than the outlet will affect the airflow through the counter and alter the calibration.

An example of incorrect use might involve measuring the particle counts in a laminar flow hood that was modified with access ports. If only the isokinetic probe was placed into the access port, and if the hood was operating at positive pressure, the airflow through the particle counter would be altered. However, if the entire particle counter was placed in the hood, the inlet and outlet pressures would be equal, and there would be no error introduced.

3.3 USING THE REMOTE SAMPLING PROBE AND TUBING

To begin counting, press the **ON/OFF** button. The LCD display should light up. If the LCD display will not turn on, it's likely your unit needs recharging. The LCD display will display the latest stored data prior to the last power off.

Select the appropriate operating options on the soft touch keypad including particle size, display mode (total particles or particles per cubic foot) and sampling mode (single, automatic or continuous). Update the count time, date and time as necessary using the **MODE** key.

Remove the remote sampling probe from its package and screw it into the top receptacle of the APC-1000, being careful not to overtighten. Attach one end of the remote sample tubing to the open end of the remote sampling probe. Insert the isokinetic probe into the other end of the remote sampling tubing. Place this end of remote sample tubing at the sampling site. To begin counting, press the **START/STOP** button.

Note: Maximum recommended length of remote sample tubing is 5 feet.

Note: Observe the precautions in 3.2.1 regarding inlet and outlet pressures and their effect on the air flow rate.

3.4 SETTING OPTIONS

Various operating parameters can be set on the APC-1000 using the **MODE** key.

3.4.1 Setting the Sample Time, Clock and Date

To change sample times for the **SNGL** or **AUTO** collection modes, depress the **MODE** and **START/STOP** keys simultaneously. The Count Time (CT) indicator will appear on the lower right corner of the LCD display while the sample hour starts blinking. Press the **STO** button to decrease or the **RCL** button to increase the hours up to a maximum of seven.

After selecting the number of hours, press the **MODE** button again and the sample minutes will start blinking. Repeat the above procedure to change the minutes of the counting period. Press the **MODE** button again to change the seconds.

After setting the counting period, press the **MODE** button again. This causes the clock hour display to start blinking. The clock time can be set in the same manner as the count time.

After setting the clock, press the **MODE** button once again. This will cause the date to appear with the month figure flashing. The date can be changed in the same manner as the sample time and the clock.

After setting the date, press the **MODE** button to return to the standard LCD display mode.

3.5 VIEWING STORED SAMPLE DATA

3.5.1 Sample Time

The elapsed time of a sample can be viewed either during or after completing a sample. To view the sample time for the displayed sample (or the one currently being collected) press the **MODE** button repeatedly until the CT symbol appears in the bottom right corner of the LCD display. The actual sample time will appear on the display even if the count was not taken for the full sample period.

3.5.2 Particle Counts

The APC-1000 stores count information in 200 "locations" of non-volatile memory. The information is automatically stored after each sample. Data storage will also take place if the instrument is manually stopped without completing the full sample time. The actual sample time will be stored and can be reviewed along with the particle count data for each location.

Note: Do not press the STO button to save data. This will display the contents of memory location 1. To return to the memory location of the last sample, first press the STO button, then press the RCL button.

To view data stored in memory the counter must be stopped. To review counts already stored in memory, press the **RCL** button. After each press of the **RCL** button the message "Loc XXX" will flash on the screen where "XXX" is the location (1 to 200) currently displayed. If the **RCL** button is held down, the memory location will decrement rapidly. To return to the last occupied memory location, press the **STO** button to go to memory location 1, then press the **RCL** button to return to the last occupied memory location.

After calling up a specific location, you can view the particle size counts by depressing the appropriate particle size buttons (**0.3, 0.5, 1.0** or **5.0**). You can view this information in cubic feet or total count mode by toggling the **/FT^3** button until the /FT^3 indicator on the LCD changes to the preferred mode. To view the actual count time, depress the **MODE** button until the CT symbol appears in the bottom right of the LCD display, showing the actual data collection time.

After completing the current data run, and printing or downloading the data, simultaneously depress the **STO** and **START/STOP** button to clear the memory locations.

Note: Be careful not to depress the STO and START/STOP buttons simultaneously until you are done reviewing the data. Pressing the STO and START/STOP buttons simultaneously clears all the memory locations in the APC-1000 and resets the counter to Loc 1 for storage of the next data set!

3.6 TEMPERATURE AND HUMIDITY SENSORS

The APC-1000 contains an integrated circuit (IC) that measures both temperature and relative humidity. The IC is embedded inside the instrument. As a result, the temperature and relative humidity displayed on the LCD display do not depict instantaneous responses to changes in temperature and relative humidity.

An important part of the temperature measurement system is the isokinetic probe. The probe acts as a fin to transfer heat to or from the temperature sensor. With the isokinetic probe installed, and air flowing through the particle counter in either the AUTO mode or the CONT mode, the readings will stabilize within 10 minutes for both temperature and relative humidity. The response time will be significantly longer if there is no air flow. Therefore, for optimum response from the temperature and relative humidity sensor, the isokinetic probe should be firmly attached, and the unit should be run for at least 10 minutes before accurate readings can be obtained.

The above should also be considered when using the remote sampling probe. If there is a temperature differential between the sampling location and the actual location of the APC-1000, the temperature displayed will be somewhere between the temperature at the sampling location and that of the APC-1000 location.

4. MAINTENANCE INFORMATION

Note: There are no user serviceable components in the APC-1000. Tamper proof screws are used to secure the cover to the sensor case. Send the complete instrument to an authorized Biotest service center for repair or calibration. Failure to follow the manufacturer's recommendations may damage the APC-1000 and will void the warranty.

Note: The APC-1000 is calibrated at the factory using isotropic polystyrene spheres according to the procedures outlined in ASTM F-328 and ASTM F-649. It is recommended that the instrument be returned to the factory annually for calibration.

4.1 FLOW RATE

The APC-1000 operates at a sampling flow rate of 0.1 cubic feet per minute. Refer to section 3.2.1 for more information about maintaining this flow rate.

4.2 BATTERY

The APC-1000 is equipped with a 6 volt sealed lead acid battery which operates the vacuum pump, and powers the laser and all of the electronics. The battery is fully charged prior to shipment, however, it is recommended to charge the battery overnight prior to initial use.

If the battery cannot produce the necessary voltage for maintaining normal operation of the APC-1000, a "low battery" indicator will blink on the LCD. By attaching the battery recharger to the APC-1000, the instrument will remain fully functional even while recharging. If the recharger is not attached, the instrument will eventually turn itself off and will not turn back on until the recharger is connected. In some cases, it may take a few minutes before the unit will become functional.

Note: It is recommended to keep the particle counter plugged into the battery recharger, and the recharger plugged into a power receptacle, whenever the APC-1000 is not in use.

4.2.1 Optional Power Supply

To operate the unit continuously in the AUTO mode for an extended period of time, the standard battery recharger cannot supply enough power. The battery alone will power the unit for up to 8 hours. Plugging in the standard recharger will extend the operating time to approximately two days if the battery is initially fully charged. To run the unit longer, Biotest offers an optional power supply that will run the particle counter indefinitely.

4.3 CLEANING THE PARTICLE COUNTER

The particle counter may be cleaned using isopropyl alcohol or most commercial disinfectants. Gently wipe the exterior with a moistened wipe. Under no circumstances should liquids be poured onto the APC-1000 or aspirated into the inlet, nor should the unit be submerged in any liquids. Do not autoclave the particle counter.

5. COMPUTER INTERFACE

An RS-232 cable is required to link the APC-1000 to a personal computer. This cable is included with the APC-1000. The particle counter connects directly to an IBM compatible personal computer through the serial port. No additional multiplexer or interface processor is required.

To connect the APC-1000 and the computer, with the APC-1000 turned off, attach the 3 pin mini connector on the RS-232 cable to the APC-1000. Attach the 9 pin interface cable connector directly to an IBM compatible personal computer through either serial port 1 or 2.

5.1 DOWNLOAD UTILITY SOFTWARE

The standard APC-1000 software package consists of two main files, APC.EXE and DOWNLOAD.EXE. The DOWNLOAD.EXE program allows collected data to be dumped into an ASCII file called DOWNLOAD.PRN which can be manipulated using spreadsheet software. The program APC.EXE allows the data the instrument is collecting to be viewed on the computer screen in real time.

5.1.1 DOWNLOAD Software Operation

To run the download program put the DOWNLOAD/APC software in drive A: of the computer. Connect the RS-232 cable to the computer and the APC-1000 while the APC-1000 is turned off. Turn on the APC-1000 and type "DOWNLOAD" on the computer at the A: prompt. If the APC-1000 is connected to the COM2 port, type "DOWNLOAD 2". All the stored information in the APC-1000 will appear on the computer screen. All stored data will be saved on the disk in your A: drive in a file called DOWNLOAD.PRN.

To download the information to the computer in per cubic foot format, type "DOWNLOAD /ft3" or "DOWNLOAD 2 /ft3" (if you're using COM2). The /FT^3 symbol will appear on the far right of the screen.

Note: For Windows™ 3.1, in the Program Manager, click on File, then Run, and type in the command line as given above (A: DOWNLOAD). For Windows® 95, click on Start, then Run, and type in the command line.

5.1.2 Importing DOWNLOAD.PRN File into Lotus® 1-2-3®

Lotus 1-2-3 can be used to view and manipulate the stored data. To read the PRN file into Lotus 1-2-3, enter Lotus and type /**F**ile **I**mport **N**umbers. This will read the DOWNLOAD.PRN file as a series of columns showing the location, time, date, count time, temperature, relative humidity, and particles by size range. Once the DOWNLOAD.PRN file is loaded into the computer, it can be manipulated as with any standard spreadsheet file to make calculations, charts, etc.

5.1.3 Importing the DOWNLOAD.PRN File into Microsoft® Excel 5.0

To import the DOWNLOAD.PRN file into Excel 5.0, first select **File Open** from the menu bar. In the file dialog box, under "List Files of Type", select Text Files. Now select the file DOWNLOAD.PRN from the directory where DOWNLOAD.EXE was run. Click the OK button, and the Text Import Wizard window will appear.

Now, select the "Delimited" radio button, and the Next button at the bottom of the window. In the second window, select the delimiter "comma." Select Next to go to the final window.

Select General Data Format, and click on Finish. The data will now be located on sheet 1 of the newly created spreadsheet. Rename the data to a meaningful file name using **File Save As.**

5.1.4 Importing DOWNLOAD.PRN File into Microsoft® Excel 4.0

Downloading the Biotest DOWNLOAD.PRN file to Excel 4.0 is a two step process. First, translate the file into a format Excel 4.0 can understand. Second, parse the file so the columns line up correctly with their column headings.

Translating the DOWNLOAD.PRN File:

To translate the DOWNLOAD.PRN file, carry out the following steps after downloading the data from the APC-1000 into the DOWNLOAD.PRN file. If you have not downloaded the data, refer to the APC-1000 Operations Manual for further details (see Section 5.1.1).

1. Open the "Q + E" file in the Excel 4.0 Windows file folder. Its icon should appear in the same file folder with the Excel 4.0 file.

2. Use the **File Open** commands to get to the File Open dialog box. Within this dialog box click on the "Source" field and select "TextFile" as the source type. Type in the correct file name in the File Name box {likely file names are either a:\DOWNLOAD.PRN or c:\remote\DOWNLOAD.PRN}.

3. Press the "Options.." button on the File Open dialog box. Click on the boxes next to the choices "Fixed-Length Values" and "First Line Contains Field Names." Press the "OK" button to exit the Options dialog box.

4. Press the "OK" button to exit the File Open dialog box.

   The screen should now have the DOWNLOAD.PRN data displayed. The data should now be in one column only and have commas between the characters. Before exiting the Q + E program, save this file:

   Use the **File Save As** command to open the "File Save As" dialog box. Use the pull down menu to open the "Destination" choices and select the "ExcelFile" option. Type in a file name for the data in the "File Name" field, ending with ".xls". Press the "OK" button to save the file.

5. Exit the Q + E program.

Parsing the Translated DOWNLOAD.PRN File:

At this point enter Excel 4.0. Before manipulating the data, however, it is necessary to perform a parse operation to put the data in a usable format. The DOWNLOAD/APC program disk contains a Macro file which will do this automatically. Do the following:

1. Open Excel on the computer.

2. Use the **File Open** command to open the file saved in Q + E.

3. Use the **File Open** command to open the macro entitled "Macro1.xlm" on the DOWNLOAD/APC program disk (or on the hard drive if running the dump utility from a fixed disk).

4. If the macro file opens on the screen, use the **Window Hide** command to hide the macro and get back to the data file.

5. Press the "CTRL" and "a" keys simultaneously to start the macro.

When the macro is through, the data should be in columns with appropriate headings. The data is now ready for normal Excel 4.0 manipulation.

5.2 APC SOFTWARE OPERATION

By typing "APC" or "APC 2" (if using COM2) a readout consisting of the four particle size channels, temperature, relative humidity, time and date will appear on the screen. In addition, the APC command will automatically set the time and date of the APC-1000 to that of the computer.

To run the APC program in per cubic foot mode, the **/FT^3** button (with the /FT^3 symbol showing on the LCD) must be pressed when the APC or APC 2 command is typed. When the /FT^3 is not displayed on the particle counter, the APC program will appear in cumulative particles mode. You may change between cumulative and /FT^3 mode at any time. If the mode is changed on the APC-1000, the display will automatically change on the computer.

Note: For Windows™ 3.1, in the Program Manager, click on File, then Run, and type in the command line as given above (A: APC). For Windows® 95, click on Start, then Run, and type in the command line.

Note: DO NOT connect the APC-1000 to the computer and printer at the same time or neither will work!

6. ACCESSORIES

6.1 PURGE FILTER ASSEMBLY

The purge filter assembly allows you to check the background readings of the APC-1000 to determine if the system has a leak or the calibration has drifted. To attach the purge filter assembly, remove the isokinetic probe, then screw the filter connector into the threaded receptacle at the top of the APC-1000. Be sure the purge filter seats firmly against the O-ring.

To test the background reading of the system, turn on the APC-1000 with the purge filter assembly in place. Allow the unit to run for five minutes to clear any loose particles from the system. Turn the APC-1000 off and restart it in the total particles mode at a setting of 0.3 microns. The reading should remain low (less than 10). If the unit registers considerably higher readings, turn it off and back on again. If the unit fails again, check the seal of the O-ring. If it fails once again, it may be time to have the unit serviced.

The purge filter assembly may also be used to clean the system. By running the APC-1000 for about five minutes with the purge filter assembly installed, any loose particles which might have deposited in the system due to use in a dirty environment will be cleaned. If particles are still registering, continue to purge the particle counter for approximately 15 minutes. If the unit fails once again, it may be time to have the unit serviced.

6.2 SERIAL DOT MATRIX PRINTER

6.2.1 Printer Set Up

A printer RS-232 interface cable is supplied with the Serial Dot Matrix Printer. The printer interface is compatible with several types of serial printers. Biotest supplies a very convenient thermal printer which works well for portable use of the APC-1000.

With the APC-1000 turned off, connect the RS-232 cable to the counter and the serial printer. The 6 pin connector plugs into the printer and the 3 pin connector plugs into the APC-1000.

The DIP switch settings for the printer must be set properly so that the particle counter and the printer communicate properly. All switches should be in the off position except for switches 2 and 4, which should be on. Do not use the default settings in the printer manual, or the printer will not work with the APC-1000.

6.2.2 Printing in Real Time

To print the data from each sample after it is acquired, connect the RS-232 cable to the printer and the particle counter. This connection should be made while the APC-1000 is turned off. Switch on the power to both units. The printer will respond by printing a header which contains the date, the count time and sampling parameters. Begin sampling. Each time the particle counter pauses or stops, a printout of the data will automatically occur showing the time, temperature (degrees Celsius), relative humidity and counts by particle size.

```
BIOTEST DIAGNOSTICS CORPORATION
APC-1000
00/00/00  CT=00:01:00

Time    T RH  0.3um  0.5um  1.0um  5.0um
1:41   11 27  23463  16746   3294     28
1:42   11 27  23409  16393   3110     22
1:43   11 27  23338  16436   2986     23
```

6.2.3 Printing Stored Data

To print stored data, connect the RS-232 cable from the particle counter to the printer. This connection should be made while the APC-1000 is turned off. Switch on the power to both units. The printer will respond by printing a header which contains the date, the count time and sampling parameters. To download all stored information hold down the **RCL** button while pressing **START/STOP**. The printout is in tabular form beginning with the last sample location and descending to location 1. The printout contains location, temperature (degrees Celsius), relative humidity, and all four counts by particle size.

```
BIOTEST DIAGNOSTICS CORPORATION
APC-1000
00/00/00  CT=00:01:00

LOC   T RH   0.3um  0.5um  1.0um  5.0um
  3  11 27   23463  16746   3294     28
  2  11 27   23409  16393   3110     22
  1  11 27   23338  16436   2986     23
```

6.2.4 Printing in Per Cubic Foot Mode

The particle counter will print in per cubic foot mode when the **/FT³** button has been depressed such that the /FT³ symbol is visible on the LCD display. When the information downloads to the printer in per cubic foot mode, an asterisk (*) will print between the RH and the 0.3 micron count on the printout. When downloading all stored information (holding **RCL** and pressing **START/STOP**), data will download in the mode which was last selected.

```
BIOTEST DIAGNOSTICS CORPORATION
APC-1000
00/00/00  CT=00:01:00

LOC   T RH  0.3um  0.5um  1.0um  5.0um
  3  11 27*234630 167460  32940    280
  2  11 27*234090 163930  31100    220
  1  11 27*233380 164360  29860    230
```

6.3 BENCH TOP STAND

A custom bench top stand is available for hands-free operation. The stand provides a means of positioning and securing the APC-1000 on horizontal surfaces so the display is easily seen by operators.

6.4 REMOTE SAMPLING PROBE AND TUBING

For your convenience, a remote sampling probe and tubing permit remote sampling with the APC-1000. Please see section 3.3 for details.

7. TROUBLESHOOTING

Note: Always turn off the power (on/off key) to the APC-1000 before connecting or disconnecting any cables.

Note: There are no user serviceable components in the APC-1000. Tamper proof screws are used to secure the cover to the sensor case. The instrument contains an infrared laser (class IIIb) and should only be opened by trained personnel as authorized by Biotest Diagnostics Corporation. Send the complete instrument to an authorized Biotest service center for repair or calibration. Failure to follow the manufacturer's recommendations may damage the APC-1000 and will void the warranty.

Observed Problem	Possible Solutions
If there are unfamiliar or no characters on the display...	Turn unit off, then on. Check for flashing characters on the display during operation which indicates insufficient battery output. Connect the battery recharger to the APC-1000 to maintain normal operation (see section 4.2)
If no characters appear on the display after the instrument is connected to the battery recharger for at least 15 minutes...	Unplug the unit from the battery charger for at least twelve hours. Then, reconnect the battery recharger, wait five minutes and attempt to restart the instrument.
If dashes appear on the LCD...	That particular memory location has no valid data.
If the particle count is erratic...	You may be sampling in the /FT^3 mode (see section 3.1.4).
	There is a possible obstruction in the flow path or contamination of the system. Use the purge filter assembly to attempt to clear the path as described in the section 6.1.
	The battery may require charging (see section 4.2).

If there are no communications between the computer and the APC-1000...	Check the RS-232 interface cable connections.
	Make sure both the APC-1000 and the computer are turned on.
	Make sure the APC-1000 is not simultaneously connected to both computer and printer.
	The computer connector may be in COM2 rather than COM1. If so, type DOWNLOAD 2 and APC 2 when using these programs.
	Exit communication program and turn off the APC-1000. Turn the APC-1000 back on and restart the program.
If there are no communications between the printer and the APC-1000...	Check the RS-232 interface cable connections.
	Make sure both the APC-1000 and the printer are turned on.
	Make sure the APC-1000 is not simultaneously connected to both computer and printer.
If Lo bAt flashes on the LCD...	The battery has reached 5.5 volts and needs recharging. When this occurs, the memory can be recalled but the instrument will not count unless connected to the recharger (see section 4.2).
If the APC-1000 automatically turns off and will not turn on...	The battery has reached 4.5 volts. The instrument will not turn on until connected to the recharger. When this occurs, the date, time, mode and sample count time will need to be reset. (To reset, see section 3.4.1). In cases where the battery is discharged to a very low voltage, the battery may need to be replaced.

APPENDIX A
SPECIFICATIONS

Illumination Source	20 mW laser diode at 820nm
Particle Size Ranges	0.3, 0.5, 1.0, 5.0 microns
Flow Rate	0.1 cubic foot per minute ± 10%
Signal to Noise Ratio	> 2:1 at 0.3 microns
Calibration	NIST traceable with polystyrene spheres as per ASTM F-328 or ASTM F-649
Display	Multi-line, six digit LCD display
Data Displayed	Total particles or particles per cubic foot Temperature Sensor: 10°C to 50°C ± 2°C Relative Humidity Sensor: 20 to 95% RH ± 10%
Mode	Actual count, sample time, time or date
Sampling Mode	Single, automatic, or continuous
Count Time	One second up to eight hours
Memory	Selective storage of 200 sample points
Output	Serial RS-232C. Baud rate of 9600
Power	One 6-volt sealed lead acid battery
Environment	Temperature: 0° to 50 °C (32° to 122°F) Humidity: 0 to 95% (noncondensing)
Dimensions	7.7 x 3.8 x 2.6 inches
Weight	2.5 pounds

Biotest Diagnostics Corporation reserves the right to change specifications without prior notice as part of our continuous product improvement program.

APPENDIX B
PRODUCT WARRANTY

Biotest (hereinafter "Seller") warrants that the manufactured products delivered under this order will be free from defects in material and workmanship under normal use and service for a period of one (1) year from date of shipment of the product to Buyer's plant.

Seller's sole obligations under this Warranty, are to replace, repair or give credit for, at Seller's option, at its factory, any of said products which shall within one (1) year after shipment, be returned to Seller's factory of origin, transportation charges prepaid, clearly marked with Return Material Authorization (RMA) number obtained from Seller, and which are, after inspection, discovered to Seller's satisfaction to be defective. The original warranty is extended as a result of the repair or replacement of any product.

THIS WARRANTY IS STATED IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, STATUTORY, OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON SELLER'S PART, AND IT NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR SELLER ANY OTHER LIABILITIES IN CONNECTION WITH THE SALE OF THE SAID ARTICLES.

This Warranty shall not apply to any product which shall have not been maintained in accordance with any handling or operating instructions supplied by Seller, or which shall have been subjected to unusual physical or electrical stress, misuse, abuse, negligence or accidents. Parts of any product consumed or subject to replacement from normal wear and tear or usage, including (but not limited to) the filter are not subject to this Warranty.

This Warranty is given to Buyer only and may not be assigned to any third party without the prior written consent of Seller.

SELLER SHALL NOT, UNDER ANY CIRCUMSTANCES, BE LIABLE TO BUYER FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LOSS OF USE, OR OTHER COMMERCIAL LOSS OF WHATEVER NATURE ARISING OUT, CONNECTED WITH, OR RESULTING FROM THE SALE BY SELLER OF ANY PRODUCT ORDERED HEREUNDER, INCLUDING WITHOUT LIMITATION, ANY LIABILITY OF BUYER TO A CUSTOMER TO WHOM BUYER SOLD A PRODUCT OR EQUIPMENT CONTAINING A PRODUCT SOLD HEREUNDER.

APPENDIX C
QUICK REFERENCE GUIDE

TO BEGIN COUNTING	Select sample options **SNGL** - single count, hold **AUTO** - count, hold, count, etc. **CONT** - continuous count until **STOP** is selected Select size channel **0.3, 0.5, 1.0, 5.0**
TO RECALL COUNT	Press **RCL** until desired location is reached (hold down **RCL** to rapidly scroll through the memory)
TO RETURN TO LOC 1	Press **STO** (note: **STO** does not store data, this is done automatically after each sample)
TO ERASE MEMORY AND RETURN TO LOC 1	Press **STO** and **START/STOP** simultaneously
TO SET COUNT TIME	Press **MODE** and **START/STOP** simultaneously Select **STO** for increasing and **RCL** for decreasing Select **MODE** once more for another selection To conclude, press **MODE** until blinking stops
TO CHANGE THE CLOCK	Follow the same procedure as the count time
TO CHANGE THE DATE	Follow the same procedure as the count time
TO PRINT STORED DATA	Press **RCL** and **START/STOP** simultaneously
TO PRINT DATA IN /FT³ MODE	Press the **/FT³** button on the particle counter, then press **RCL** and **START/STOP** simultaneously
USING THE DOWNLOAD/APC PROGRAM IN /FT³ MODE	Type DOWNLOAD /ft3 or DOWNLOAD 2 /ft3; press the **/FT³** button on the APC-1000 for APC.EXE

APPENDIX D
EUROPEAN COMMUNITY DECLARATION OF CONFORMITY

Declaration of Conformity

Application of Council Directive(s): 73/23/EEC, 89/336/EEC

Standard(s) to which conformity is declared: EN61010-1, EN55011, EN50082-1

Manufacturer's Name: Biotest Diagnostics Corporation

Manufacturer's Address: 66 Ford Road
Suite 131
Denville, NJ 07834 USA

Importer's Name:

Importer's Address:

Type of Equipment: Airborne Particle Counter

Model: APC-1000

Serial Number:

Year of Manufacture:

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.

Place: Denville, NJ USA

David R. Miers
(Signature)

Date: July 30, 1996

David R. Miers
(Full Name)

Manufacturing Manager
(Title)

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